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2000BSER

DIGITAL PANEL COUNTERS • DIGITAL PROCESS MONITORS • TRANSDUCER CONDITIONERS • COUNTER/TIMERS • TACHOMETER/COUNTERS • PRINTERS •
TACHOMETER / COUNTERS • DIGITAL DATA PRINTERS • REMOTE DISPLAYS • DIGITAL COMPARATORS • DIGITAL MICROVOLT METERS •
POWER SUPPLIES • DIGITAL COMPARATORS • DIGITAL MICROVOLT METERS •

DIGITAL PANEL METER OWNERS MANUAL

DIGITAL
PANEL METER
MODEL 2000B
P/N 101749
DRANETZ ENG. LABS.

• DATA AMPLIFIERS • PRINTERS • DIGITAL COMPARATORS • DIGITAL VOLT METERS • DIGITAL PYROMETERS • LOW LEVEL SCANNERS • REMOTE DISPLAYS •
• NEWPORT LABORATORIES B.V., P.O. BOX 7759, SCHIPHOL-EAST, THE NETHERLANDS • TELEPHONE: (20) 45-20-52 • TELEX: 84416347 • •

SERIES 2000B/SER
DIGITAL PANEL METER
OWNERS MANUAL

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CERTIFICATION

Newport Laboratories, Inc., certifies that this (these) instrument(s) was (were) thoroughly inspected and tested at the factory prior to shipment and found to meet all requirements defined by the contract under which they are furnished.

WARRANTY AND ASSISTANCE

All products of Newport Laboratories, Inc., are warranted against defective material and workmanship for a period of one year from the date of delivery. Newport Laboratories will repair or replace all defective equipment returned to it (transportation charges prepaid) during the warranty period, without charge provided there is no evidence that the equipment has been mishandled or abused. This warranty does not apply to expendable parts or materials whose normal life is less than the warranty period, nor is Newport Laboratories liable for consequential damages arising out of the use or handling of its products.

In all orders for service, please include the model and serial number and the name of the original purchaser of the equipment.

SECTION 1

DESCRIPTION

1.1 General

For applications of up to 0.0025% resolution, the Series 2000B offers a low-cost, reliable approach to digital display of analog voltages and currents. Series 2000B/SER digital panel meters provide +39,999 count readings with a full scale of 3.9999 volts DC. Using highly-stable integrating techniques, the Series 2000B can complete from 4 to 30 readings per second. Upon command, all Series 2000B DPM's will hold a reading indefinitely. True differential inputs, isolated from power line, case and BCD grounds, prevent ground-loops and tedious system trouble-shooting.

Series 2000B/SER meters allow the decimal point to be set externally to any one of five positions. The BCD outputs and the external control inputs and outputs are compatible with TTL and DTL for ease in interfacing with other instruments.

The gated BCD output may be used to form a digital multiplexer, so the BCD lines of several DPM's may be parallel-wired and multiplexed to a common recorder. Each DPM would then be sequentially enabled and its BCD data would appear on buss lines driving the recorder. Buffers provide isolation so that noise on the BCD outputs will not affect the reading stored in the DPM. For ruggedness and shielding against external noise, the 2000B is housed in an extruded aluminum case.

1.2 Specifications (Basic 4V Range)

Full Scale	+3.9999 volts D.C.
Input Current Max	10nA bias, 2nA offset
Resolution	100uV
Impedance Min	1G Ohm
Accuracy and Stability	
Zero - Drift	
Temperature	1 count per 15°C
Time	1 count per 60 days

Full Scale	
Temperature	Maximum drift - 12 PPM/°C
Time	60 days - 0.01%R
Non-Linearity	±1 count maximum
Calibration Setability	Zero, Full Scale, Zero width, and + Gain balance available from rear panel. Optional Fine Zero and Full Scale screwdriver adjustments accessible from front panel.
Internal Read Rate	4/sec to 30/sec programmable by external resistance
Settling Time	After full scale step input, to within .01% of final value, 500 ms standard
Normal Mode Rejection	28 db (60 Hz) with standard filter
Polarity	Automatic
Common Mode Rejection, DC to 60 Hz	
To power line, case	100 db
To BCD common	80 db
Common-Mode Voltage, to meet CMR Specification, (either input)	
To power line, case	300 volts
To BCD common	6 volts
Remote Controls	BCD enable and reading hold
Operating Temperature Range	0 to 55°C
Storage Temperature Range	-40 to +80°C
Display	0.55-inch numerals with plus, minus indicator. Four least significant digits blank for overload indication.
Power	115/230 VAC ±10%, 50 to 60 Hz, 7 watts

Enclosures

2.2" high x 4.35" wide x 4.9" deep
with connector, extruded aluminum
case; bezel (option A3) has remov-
able name plates for replacement
by customer nomenclature

Weight

Less than 3 pounds, net; 5 pounds,
shipping

CONNECTOR TYPES (Option D2)

Analog Connector

SAE No. SAC 10D/1-2 or
CINCH NO. 251-10-30-160

Digital Connector

SAE No. SAC 15D/1-2 or
CINCH No. 251-15-30-160

Key

SAE No. 007900 or
CINCH No. 456-99-99-193

Connector Key Position

Analog Connector

between pin 3 and pin 4

Digital Connector

between pin 11 and pin 12

SECTION 2

RECEIVING AND INSTALLATION

2.1 Unpacking and Inspection

Your Series 2000B digital panel meter has been carefully inspected and tested before shipment. Unpack the meter and perform a visual inspection to assure that no damage has occurred during shipment or handling. These meters are factory sealed units. The only controls that may require periodic adjustment are accessible through the front or rear panel. Because extensive damage could result from attempts to measure circuit parameters or to trouble-shoot the meter by unqualified personnel, the warranty is voided if the unit has been removed from its case and shows signs of unauthorized repair.

2.2 Installation-Mechanical

Drawing 03779 illustrates the detailed method of mounting the panel meters for each of the three mounting options. All critical dimensions are shown including those for the panel cutout.

<u>MOUNTING STYLE</u>	<u>DESCRIPTION</u>
A1	Unit is mounted flush on studs behind a rack panel.
A2	Unit is mounted behind a rack panel by inserting the furnished 6-32 screws through the rack panel and into threaded holes in the case.
A3	Unit is mounted through the rack panel from the back and held in place from the rear by a "U" bracket. The mounting cutout is hidden by the instrument bezel.

2.3 Initial Checkout Procedure

Hook up meter according to Fig. 2-1 (See Section 3.1 for 230 volt operation).

1. Connect a voltage source (eg. power supply) between pins 10 and 9 on the upper (Analog) connector.
2. Connect a jumper between pins 7 and 9 on the same connector.
3. Connect a power cord to the upper (Analog) connector as follows:
 - A. To pins 1 and A connect the high or "hot" lead.
 - B. To pins 2 and B connect the low or "cold" lead.
 - C. To pins 3 and C connect the earth ground or "third wire".

It is necessary to connect to both pins indicated at each connection.

4. Apply 115 VAC, $\pm 10\%$, 50-60 Hz to the power cord.
5. Adjust the input voltage source to be within the measurement range of the meter and verify that the meter is reading correctly.

CAUTION

Accidental connection of power to the
Digital Board can result in catastrophic failure

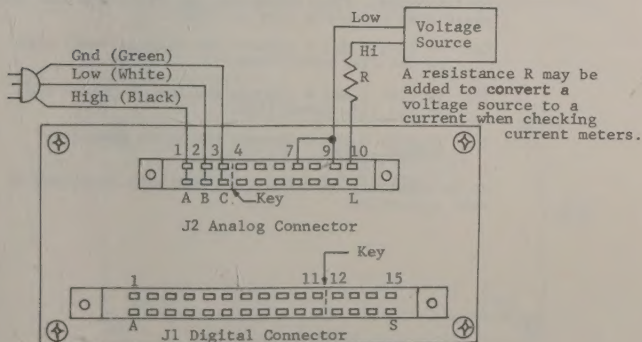


Fig. 2-1

SECTION 3

OPERATING INSTRUCTIONS

3.1

Power

Description

The standard meter operates from a 115V or 230V, $\pm 10\%$, 50-60 Hertz power source. It dissipates approximately 7 watts. It should be connected to the power source by a three conductor cable. Two conductors provide the power to the meter and the third provides safe grounding of the case. The third conductor should connect to earth ground at the power end of the cable and to the Analog Connector at the meter end of the cable. A wire from the Analog board to a locking terminal lug completes the connection to the case when the lug is secured by the rear panel screw.

CAUTION

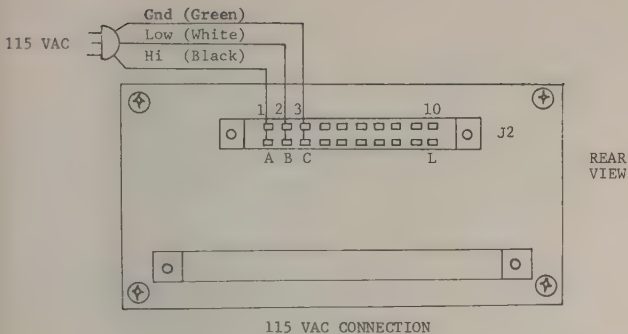
Accidental connection of power to the Digital Board can result in catastrophic failure.

Wiring Detail, 115 VAC Operation

The power cable is connected as follows to the top or Analog board. (This connector may be a single or double sided when operating only on 115V).

- (a) To Pins 1 and A connect the high or "hot" side of the 115v power line.
- (b) To Pins 2 and B connect the low or "cold" side of the 115v power line.
- (c) To Pins 3 and C connect the earth ground or "third wire".

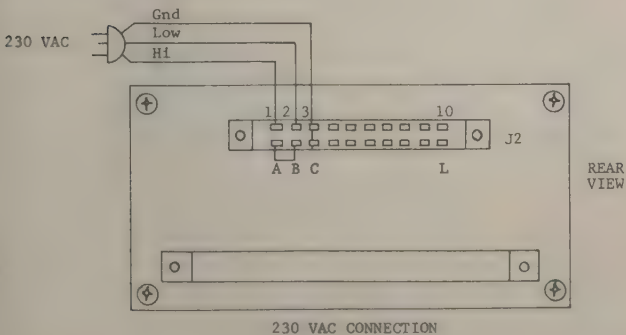
It is necessary to connect to both pins indicated at each connection.



Wiring Detail, 230 VAC Operation

The power cable is connected as follows to the top or Analog board.

- To Pin 1 connect the high or "hot" side of the 230v power line.
- To Pin 2 connect the low or "cold" side of the 230v power line.
- Jumper Pin A to Pin B.
- To Pins 3 and C connect the earth ground or "third wire".



Signal InputsIntroduction

The 2000B series of panel meters employs a differential bipolar input circuit with 6 volts of common mode rejection between either input lead and circuit ground.

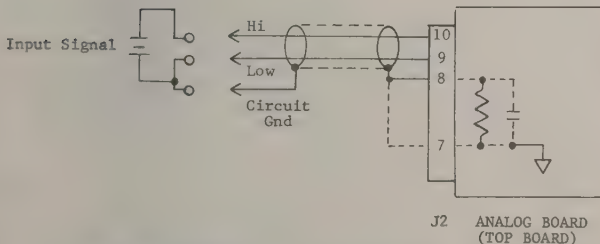
The input impedance for the basic meter is 1000 megohms minimum. An input attenuator or shunt can be added to produce other ranges of meters.

Circuit ground is the reference ground for the external control and BCD output circuits. Floating inputs require the addition of an external common mode path between the input leads and circuit ground. For this reason a guard terminal with a one megohm resistor to circuit ground is provided. Circuit ground is isolated with respect to the case or earth ground up to a potential difference of +300v.

Wiring Detail - Floating Input

When the input voltage source is completely floating from meter ground, the common mode voltage will exceed the 6v limitation due to the lack of a low impedance path for the input bias current between the input leads and circuit ground. The effect is for the readings to bounce erratically. To reduce the common mode voltage to less than 6v, pin 9 should be returned to circuit ground pin 7, directly or through the internal network on pin 8.

- (a) To Pin 10 connect a high side of the input signal.
- (b) To Pin 9 connect the low side of the input signal.
- (c) To Pin 8 (Guard) connect the meter end of the shield. Connect the other end of the shield to the low side of the source.
- (d) If the meter is used for visual readout only (eg. no external control) connect a jumper from Pin 7 to Pin 8.



The signal inputs are true differential. Therefore the high and low leads may be reversed to change the polarity indication.

INPUT SIGNAL CONNECTIONS

Input CharacteristicsInput Source Resistance

Maximum bias current for the basic meter is 10nA. 100uV of offset may be generated by an input source resistance of 10K Ohm. The error due to source resistance may be reduced by keeping equal resistances in both leads.

Input Filter

The standard input filter is a single section low pass filter having a cutoff frequency (-3db) of 4 Hz. The settling time to .01% is 500ms.

The filter cutoff frequency may be factory altered by changing the value of a capacitor to provide either a shorter settling time for faster response or a lower cutoff frequency for better noise rejection.

Since the filter is connected directly to the input, any equivalent source impedance will act to lower the cutoff frequency and increase the noise rejection and settling time. By putting equal resistance in series with both inputs, input filter characteristics may be easily changed.

When special full scale ranges are needed an external attenuator may be added to the DPM. To keep maximum accuracy source resistance in series with each input lead should be kept equal and constant. See Fig. 3-1.

NOTES:

$\frac{R1}{R2} + 1$ = Attenuation Factor

R3 = Parallel value of R1 and R2

S-1 may be added to switch the attenuator in and out of the circuit.

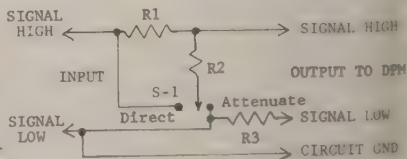


FIG. 3-1

Digital Inputs/Outputs

The logic levels present at the digital connector are DTL and T²L compatible.

(a) Input Requirements:

Low level 0 to +.8v, sink 1.6ma
High level +2.0 to +5.0v, source .1ma

(b) Output Specifications

Low level 0 to +.5, sink 10ma
High level +2.4 to +5.5v, source 6K Ohm

External Control

The digital panel meter provides a choice of several external control modes. This choice of modes allows the meter to satisfy a wide variety of interface requirements when used as a systems component.

The meter has a basic read rate of 4 conversions per second, but is capable of making measurements at a maximum rate of 30 conversions per second when the 30 Hz Read Rate input is grounded. Each conversion is synchronized to the 60 Hertz power line and always starts at the same point on the power line cycle. By means of external control any number of these cycles may be skipped with the meter retaining the reading corresponding to the last conversion. When the external command is given for a new reading the meter waits until the next synchronization point is reached on the power line cycle before starting the conversion.

The basic external control functions are labeled READ, DATA READY and BCD ENABLE. After the READ signal goes true (high) the meter starts a new conversion process at the next synchronization point on the cycle. At the conclusion of the conversion process and before the next synchronization point occurs, the DATA READY signal goes true (high). This indicates that the conversion process is complete and the information present on the data outputs is ready for use. With a low input on the BCD ENABLE input the BCD outputs will be held in the high state. The BCD ENABLE can be used to keep the BCD outputs from "RUNNING" during conversion or to enable the BCD output of one meter at a time while digitally multiplexing many parallel wired DPM's.

READ

The READ input controls the start of each conversion process. A High level (or open) enables and a Low level disables the conversion process.

An internal storage element allows one more reading to occur after the READ input goes low. When this is undesirable an internal jumper on the digital board may be cut to disable the storage feature.

Operation with Storage Jumper

The meter is normally furnished with the storage jumper. The application of a high input sets the storage element, which then remains set after the READ input goes low. The storage element is reset by the start of the next conversion cycle. The effect is to provide one more measurement after the READ input goes high. The following modes of operation exist with the storage jumper in place.

Level Mode

While the READ input is maintained true (high), measurements occur at the selected reading rate. While it is false (low), the last measurement made is held in memory. One more measurement is made after the READ input goes low. It is this measurement that is held in memory as long as the READ input remains false.

Pulse Mode

A pulse that goes high at the READ input for a minimum of two microseconds and terminates before the next synchronization point on the power line cycle will set the storage element and provide one conversion starting at the synchronization point. If the pulse extends beyond the synchronization point, an additional conversion will occur. To insure that only one conversion is made, the pulse width must be less than 300 microseconds.

Operation Without Storage

There are applications (eg. when the BCD outputs are connected to a printer) for which it is desirable to disable the storage function. This is accomplished by cutting or removing jumper W2 on the digital board. This insures that when the READ input goes low, no more conversions take place and the BCD outputs remain static for use by an external device.

Wiring Detail

The READ input signal is connected to the bottom (Digital) board.

- (a) To Pin 13 connect the high side of the input.
- (b) To Pin S connect the low side or ground return of the READ input.

3.4.2

DATA READY

The DATA READY signal goes true (high) to indicate the completion of a conversion process and remains true until the next conversion process is started. During this time the BCD outputs represent the value of the measurement and are available for use by an external device. The DATA READY signal normally remains true for at least 20 milliseconds but this time may be extended indefinitely with a low level on the READ input.

Wiring Detail

The DATA READY connection is available on the bottom (Digital) board.

- (a) Pin 14 - DATA READY output signal.
- (b) Pin S - Ground reference for the DATA READY output signal.

3.4.3

Decimal Points

Each of the five digits of the decimal readout has a left-hand decimal point which may be lighted to provide the proper decimal point representation of the quantity being measured. All five decimal points are available at the connector and may be individually selected by external circuitry.

Wiring Detail

The decimal point locations are designated by representing the four full decimal digits by 9's and placing the decimal point in the position corresponding to its display location. The decimal point connections are available on the bottom (Digital) board.

- (a) Pin 3 - Decimal Point 3999.9
- (b) Pin E - Decimal Point 399.99
- (c) Pin 8 - Decimal Point 39.999

- (d) Pin L - Decimal Point 3.9999
- (e) Pin 15 - Decimal Point .39999
- (f) Pin S - Ground reference

Any decimal point may be lighted by connecting the designated pin to ground, Pin S, either with a jumper or through relay contacts. A solid state switch could also be used if it is rated for 1ma in the ON state and is capable of blocking 90 volts with a leakage of less than 1 microampere in the OFF state.

3.4.4

BCD Outputs

Positive true BCD outputs representing each digit of the readout as well as Overload and Polarity are standard. The OVERLOAD output goes true when the input voltage exceeds the full scale rating of the meter. The POSITIVE POLARITY output goes true when the polarity of the input signal is positive.

The BCD, POSITIVE POLARITY, and OVERLOAD outputs are settled and ready for acceptance by an external device when the DATA READY signal goes true. The data may be held indefinitely by maintaining a low level at the READ input.

The BCD outputs of the Series 2000B are buffered and gated. Connecting a low signal to BCD ENABLE Pin 12 causes all the BCD outputs to go high. The gated BCD lines from several meters may be multiplexed by parallel wiring the outputs. By sequentially enabling each meter its BCD outputs will appear on the common buss. The BCD ENABLE can also be used to gate the BCD outputs off during the conversion period. This is recommended to reduce "noise" on the BCD outputs during the conversion period.

Wiring Detail

BCD Outputs

This data is on the bottom connector. The pin designations are listed on the pin assignment list. Digital ground, pin S should be used as the common reference for these signals.

BCD Enable

- (a) Pin 12 BCD ENABLE input-low to disable BCD outputs. High or open to enable.
- (b) Add a jumper from pin 14 (DATA READY) to pin 12 to gate off BCD output during conversion.

J2 - Analog Board Upper Connector

<u>PIN NO.</u>	<u>NAME</u>	<u>DESCRIPTION</u>
10,L	SIG HIGH	Signal High Input
9,K	SIG LOW	Signal Low Input
8,J	GUARD	Provides Bias Current return for input amp
7,H	CIRCUIT GND	Meter Circuit Ground
6,F } 5,E } 4,D }	SPARES	No internal connection on standard meter
3,C	POWER GND	Case & third wire gnd.
2	INPUT POWER LOW	115/230 input (connect to "B" for 115V)
1	INPUT POWER HI	115/230 input (connect to "A" for 115V)
B	INPUT VOLTAGE SELECT	Jumper to "2" for 115V or to "A" for 230V
A	INPUT VOLTAGE SELECT	Jumper to "1" for 115V or to "B" for 230V

NOTE: If operating from 115V AC only, a 10 pin single sided connector may be used for J2.

SERIES 2000B PIN ASSIGNMENTS

J1 - Digital Board Lower Connector

<u>PIN NO.</u>	<u>NAME</u>	<u>DESCRIPTION</u>
13	READ	Open to read, Gnd to Hold
R	30/SEC	Open for 4 readings per second Gnd for 30/seconds
S	CIRCUIT GND	Gnd reference for all digital inputs and outputs
14	DATA READY	Low during conversion
3	UNITS DP	Gnd to light Decimal point at 3999.9
E	TENS DP	Decimal point at 399.99
8	HUNDREDS DP	Decimal point at 39.999
L	THOUSANDS DP	Decimal point at 3.9999
15	TEN THOUSANDS DP	Decimal point at .39999
12	BCD ENABLE	Open for normal BCD output, low to force BCD outputs high

A - 1 BIT	H - 200 BIT
B - 2 BIT	7 - 400 BIT
2 - 4 BIT	6 - 800 BIT
1 - 8 BIT	9 - 1K BIT
4 - 10 BIT	10 - 2K BIT
5 - 20 BIT	K - 4K BIT
D - 40 BIT	J - 8K BIT
C - 80 BIT	M - 10K BIT
F - 100 BIT	11 - 20K BIT
	N - OVERLOAD
	P - POSITIVE POL

BCD Outputs Buffered,
Isolated, Gated,
(BIG) Positive
True

SECTION 4

THEORY OF OPERATION

4.1 General

The Series 2000B digital panel meters basically accept DC analog voltages at their input and display the value digitally with planar, neon glow, seven segment displays. The value is also available electrically in BCD form at the digital connector.

4.2 Timing

The conversion process is synchronized to the 60 Hz power line as shown in the timing diagram below. Conversion takes place during the negative portion of the cycle. During the positive half cycle the reading is held and the half-wave rectified high voltage is applied to the display tubes.

The reference current is integrated for a period of time proportional to the reading. It is zero for a reading of zero, 6ms for a reading of full scale or greater.

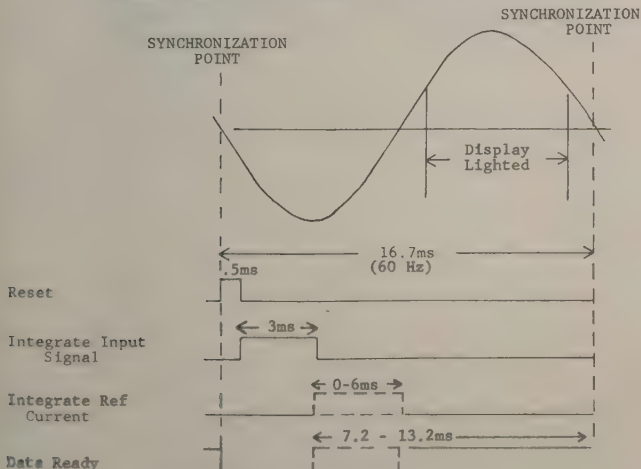


Figure 4-1 Simplified Timing Diagram

Refer to the simplified block diagram (figure 4-2) and basic timing diagram (figure 4-1).

The measurement cycle begins when the reset circuit detects the zero crossing of the falling edge of the AC line and generates a reset pulse. This reset pulse sets the BCD counter to a count of 20000 and sets the I-SW flip flop to the Signal Integrate state. The I-SW flip flop output causes the current switch to switch the signal current sink to the integrating capacitor and turns the gated oscillator on. When the integrating capacitor begins to charge down, the clamping comparator output goes high.

When the BCD counter reaches another 20000 counts and overflows the I-SW flip flop is set to the Reference Integrate state, causing the current switch to select the reference current source. At this time the BCD counter has overflowed and is at 00000 counts. The integrating capacitor discharges at a constant rate back to its initial charge at which time the clamping comparator goes low, turning the gated oscillator off. The number of counts now in the BCD counter is equal to the input voltage and the data ready signal goes true. The display is turned on each half cycle during the time data is stable.

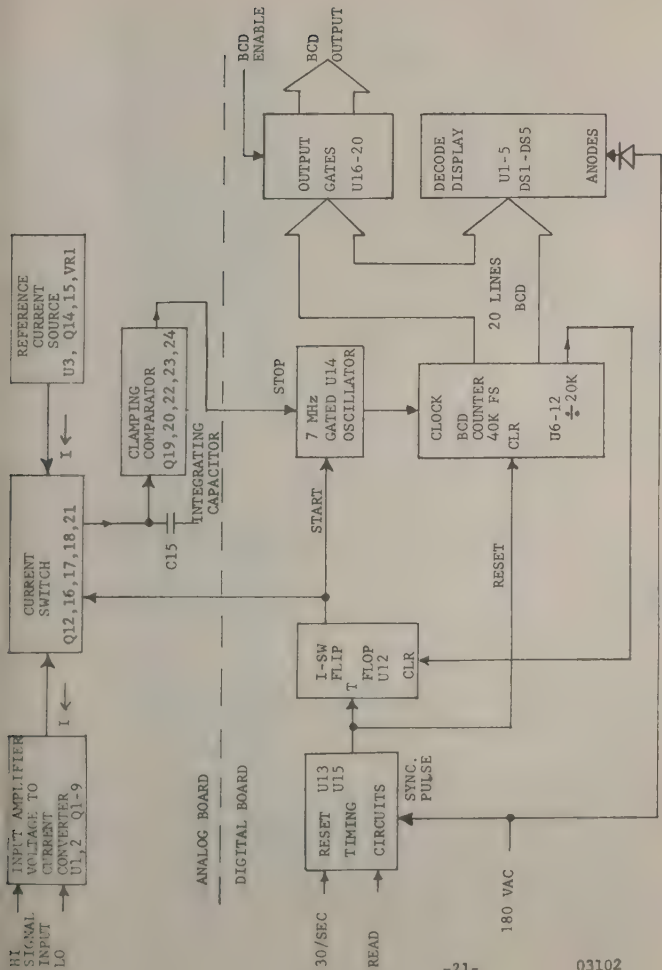
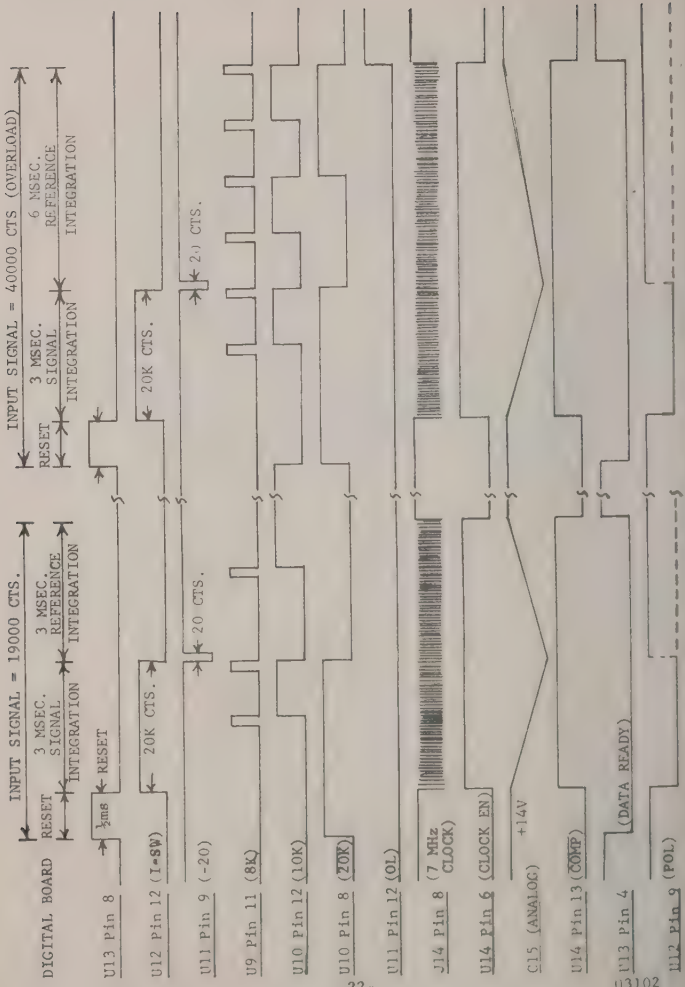


FIGURE 4-2 SIMPLIFIED BLOCK DIAGRAM



TIMING DIAGRAM 2000B SER FIGURE 4-3

SECTION 5

MAINTENANCE AND CALIBRATION

5.1 Introduction

There are four adjustments available on the basic digital panel meter. These are the ZERO adjustment, the FULL SCALE adjustment, the $\pm$ GAIN adjustment and the ZERO WIDTH adjustment. These controls are located at the rear of the meter. Optional front panel ZERO and FULL SCALE fine adjustments are located at the upper left hand corner of the front panel.

All controls should be adjusted with an insulated screwdriver according to the following instructions. Always allow at least 30 minutes warm-up time before making the adjustments.

5.2 Calibration (Recommended interval 60 days)

5.2.1 Test Equipment Required

- A. Variable voltage (current) standard with an accuracy of 0.003% such as Fluke model 343A.
- B. Precision divider such as ESI model RV622A, 6 dial, 10K Ω , 5 PPM divider.

5.2.2 Set Up

Use "Initial Checkout Procedure", Section 2.3.

5.2.3 Calibration Adjustments

A. Initial Calibration:

Zero

With the input leads shorted together, adjust R9 (ZERO) until the negative sign comes on, then adjust it slowly in the opposite direction until the positive sign just comes on. The readout should be +00000.

If the optional front panel "0" adjustment is furnished, use this control for the ZERO adjustment, above. If the front panel "0" adjustment is not near the center of its range, R9, the rear panel ZERO can be used to center it.

Zero Width

Apply positive ten counts of signal to the input (1mV on 4V meter) and adjust R29 (ZERO WIDTH) for a readout centered on +00010.

Full Scale Turn-Over

Apply a positive signal near full scale (3.5V on 4V meter) and note the reading on the unit under test. Reverse the signal polarity and if the readout is not the same, adjust R17 (+ GAIN) to take up one half of the difference. Repeat until the readout is the same in both polarities.

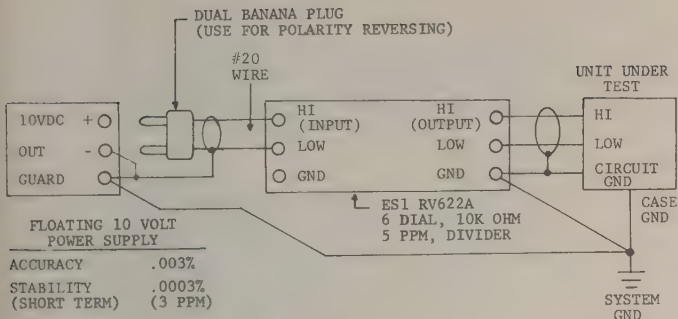
Full Scale Gain

Apply a known signal in either polarity (3V to 3.5V for a 4V meter) and adjust R34, the rear panel FULL SCALE adjustment for the correct readout.

If the optional front panel "FS" adjustment is furnished, use this control for the above adjustment. If the "FS" pot is not near the center of its range R34 the rear Full Scale can be used to center it.

B. Final Calibration:

Because the initial calibration can introduce as much as $\pm 1/2$ count of error (some of it additive) at each calibration point due to the digitizing error, it is recommended that the above initial calibration procedure be supplemented by the following procedure when the full accuracy capability of the DPM is desired. To insure maximum accuracy it is important that minimum errors are introduced by the test setup and calibration equipment. Possible unsuspected sources of error can result from dividers with resistances that are too large or too small, 60 Hz noise introduced by ground loop or stray pickup, AC or DC common mode voltages, accuracy, stability and resolution of test equipment, or wiring and switch resistance in test set.



The following will remove all calibration procedure uncertainty. Although repeating of steps is called out this is for checking only, and if the procedure is followed carefully no interaction of adjustment or repeating of steps will be necessary. In some cases it will be impossible to make the readout bounce equally between two consecutive numbers due to the finite resolution of divider and the low internal digitizing noise of 2000B/SER. In these cases it is left to the discretion of the calibrator to know what is "close enough" for his end use.

Before proceeding allow 1 hour for unit under test and the 10 volt power supply to stabilize.

Zero

Set the polarity to positive, the divider to .000200 (i.e. 20 counts, the DPM should read +00020; if not adjust R9 ZERO or front panel "0"). Now slowly advance the 10^{-6} dial ($10\mu\text{V} = .1$ count) and note the dial reading at which point the DPM is reading both 00020 and 00021 with equal consistency.

Reverse the polarity and repeat the above. If the divider is not set to exactly the same number in both polarities set the divider to the average of the two settings and adjust R9 (ZERO) or front panel "0" for equal bouncing between 00020 and 00021 on the readout. Recheck the above zero step so that when the polarity is reversed, the readout is still bouncing between 00020 and 00021.

Zero Width

Set the polarity to positive and the divider to .000206. Adjust R29 "ZERO WIDTH" until the readout is bouncing between 00020 and 00021. Reverse the polarity and if readout is not still bouncing, repeat zero and zero width steps until the readout will bounce in either polarity with the divider set to .000206 (20.6 counts, 2.06mV).

Turn Over

Set polarity to positive and the divider to .350000 (3.5V, 35000 counts; if readout is not 35000, adjust R34, FULL SCALE or front panel "FS" adjustment). Slowly rotate the 10^{-6} dial on the divider and note the dial reading that the DPM readout reads 35000 and 35001 equally. Now reverse the polarity and repeat. If the dial reading is not the same in both polarities set the dial to the average of the two readings and adjust R17 ($\pm$ GAIN) for 35000 bouncing 35001. Repeat until the readout will bounce between the same numbers in either polarity.

Full Scale

Set the polarity to positive and the divider to .350006. Adjust R14, Full Scale or front panel FS pot for a readout bouncing equally between 35000 and 35001. Reverse the polarity and if readout is not still bouncing equally repeat turn-over and full scale steps until the readout will bounce between 35000 and 35001 with either polarity input signal and the divider set to .350006.

LINEARITY CHECK

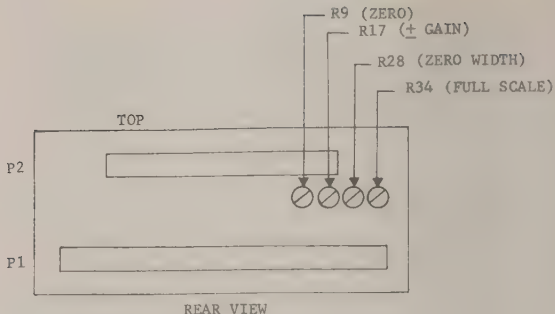
In order to measure the linearity to spec without using "Best straight line" interpretation, the final calibration procedure must be done first.

Set divider to .000106 and note that the readout bounces between 10 and 11 in both polarities. Set divider to .350006 and note that readout bounces between 35000 and 35001 in both polarities. If not, see final checkout procedure.

Set polarity to positive.

<u>Set Divider To:</u>	<u>Readout should read within +1 count of:</u>
.000000	+00000
.000010	00001
.000100	00010
.001000	00100
.010000	01000
.100000	10000
.150000	15000
.200000	20000
.250000	25000
.300000	30000
.350000	35000
.390000	39000
.450000	4

Check any other desired points, then reverse polarity and repeat.



CALIBRATION ADJUSTMENT LOCATION

5.3

Maintenance & Repair

Due to the complex operation of this instrument and special laboratory test equipment needed to repair it, no attempt should be made to troubleshoot the circuit cards in the field by untrained personnel.

Before returning the instrument to the factory, every attempt should be made to insure that the instrument is actually at fault and that the trouble is not in the set up. The best way to insure this is by substituting a known working instrument. Alternately, the meter should be removed from the set up and tested by using the initial checkout procedure (Section 2.3).

If the instrument is found to be at fault, please fill out the Returned Material Authorization and return with the unit. The best way to insure that the trouble will be quickly found and repaired is to include a diagram of your actual test conditions, so that the factory will be able to duplicate the failure easily.

If customer repair is to be undertaken, the following guide will assist in the tracing of a fault to a functional area of the meter.

Test 1

After determining that the power supplies are furnishing the correct voltages, hook up the meter per the initial checkout procedure in Section 2.3. Apply a positive and then a negative voltage to the input terminals. If the + and - indicators do not follow the input signal, look at the logic level on U12 pin 7 (Digital). If this signal does not follow the polarity of the input signal, the trouble is likely in the input amplifier circuitry on the analog board.

Test 2

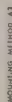
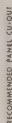
If the signal at U12 pin 7 (Digital) is correct, ground U14 pin 13 (Digital). The readout should be 00000.

Test 3

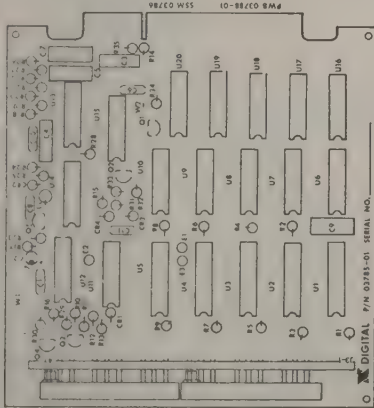
Remove the ground from U14 pin 13 (Digital) and short out R43 (Analog). The readout should be 4XXXX (Overload). If this test or test 2 produces incorrect results the trouble is on the digital board.

Using the results of these tests, the simplified block diagram, Figure 4-2, will assist in tracing the malfunction to a functional block of the meter.

Test 1 indicates if the input amplifier is following the input signal polarity. Test 2 simulates a comparator input to the digital circuitry as if the analog board was working with zero input. Test 3 simulates no comparator input to the digital circuitry as if the analog board was working with an overload input. If all three tests give correct results, look for the trouble in the reference current source or the current switch circuits. Look at the top of C15 with a 10M Ohm probe for a full scale input signal. A waveform should be observed ramping from approximately +14V to a point several volts lower during the time the signal at U12 pin 12 (Digital) is at a positive level (Signal Integration Time) and then ramping back up when the signal at U12 pin 12 is at a lower level (Reference Integration Time).

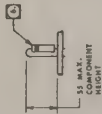


Year	Number of cases	Rate per 100,000
1990	1,100	1.1
1991	1,200	1.2
1992	1,300	1.3
1993	1,400	1.4
1994	1,500	1.5
1995	1,600	1.6
1996	1,700	1.7
1997	1,800	1.8
1998	1,900	1.9
1999	2,000	2.0
2000	2,100	2.1
2001	2,200	2.2
2002	2,300	2.3
2003	2,400	2.4
2004	2,500	2.5
2005	2,600	2.6
2006	2,700	2.7
2007	2,800	2.8
2008	2,900	2.9
2009	3,000	3.0
2010	3,100	3.1
2011	3,200	3.2
2012	3,300	3.3
2013	3,400	3.4
2014	3,500	3.5
2015	3,600	3.6
2016	3,700	3.7
2017	3,800	3.8
2018	3,900	3.9
2019	4,000	4.0
2020	4,100	4.1
2021	4,200	4.2
2022	4,300	4.3
2023	4,400	4.4
2024	4,500	4.5
2025	4,600	4.6
2026	4,700	4.7
2027	4,800	4.8
2028	4,900	4.9
2029	5,000	5.0
2030	5,100	5.1
2031	5,200	5.2
2032	5,300	5.3
2033	5,400	5.4
2034	5,500	5.5
2035	5,600	5.6
2036	5,700	5.7
2037	5,800	5.8
2038	5,900	5.9
2039	6,000	6.0
2040	6,100	6.1
2041	6,200	6.2
2042	6,300	6.3
2043	6,400	6.4
2044	6,500	6.5
2045	6,600	6.6
2046	6,700	6.7
2047	6,800	6.8
2048	6,900	6.9
2049	7,000	7.0
2050	7,100	7.1
2051	7,200	7.2
2052	7,300	7.3
2053	7,400	7.4
2054	7,500	7.5
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2056	7,700	7.7
2057	7,800	7.8
2058	7,900	7.9
2059	8,000	8.0
2060	8,100	8.1
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2068	8,900	8.9
2069	9,000	9.0
2070	9,100	9.1
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2073	9,400	9.4
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2078	9,900	9.9
2079	10,000	10.0
2080	10,100	10.1
2081	10,200	10.2
2082	10,300	10.3
2083	10,400	10.4
2084	10,500	10.5
2085	10,600	10.6
2086	10,700	10.7
2087	10,800	10.8
2088	10,900	10.9
2089	11,000	11.0
2090	11,100	11.1
2091	11,200	11.2
2092	11,300	11.3
2093	11,400	11.4
2094	11,500	11.5
2095	11,600	11.6
2096	11,700	11.7
2097	11,800	11.8
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PWB 03788-01 55M 03786

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VIEW A-A

FILLET WITH SOLDER

BY <i>DE M. S. J.</i>	DATE 15 DEC 1972	NEWPORT LABORATORIES, INC. 630 E. YOUNG ST. SANTA ANA, CALIF. 92705
CHK <i>J. D. Smith</i>	DATE 1972	TITLE ASSEMBLY DIAGRAM, DIGITAL
APPROV. <i>J. D. Smith</i>	DATE 12 07 72	CODE IDENT NO. 32873
USE OF THIS PROPRIETARY INFORMATION IS RESTRICTED TO MAIN- TENANCE OF OUR PRODUCTS.		SIZE C
ASSEMBLY REF DESIG		NO. 03786
SCALE: 2/1		MODEL 3000BSE
		SHEET 1 OF 1

- CODED END OF DIODE DENOTES CATHODE.
- RUBBER STAMP SERIAL NO. AND APPROPRIATE DASH NO.
 - ASSEMBLE PER WORKMANSHIP MANUAL 02281-01
 - REFERENCE PARTS LIST NO 03783-01
 - REFERENCE SCHEMATIC NO. 03787
 - TEST PER SPECIFICATION NO. 03782

NOTES UNLESS OTHERWISE SPECIFIED

03786
B
C
D

03787

G1 1954-1955 100

CHG	E.O. NO.	DATE	BY	CHK
A	556	11/27/77	WBP	JH
B	721	5/29/73	WBP	JH
C	761	5-30-73	RPA	JH
D	819	10-1-73	AE	JH
E	1162	10-3-74	EP	JH
F	1158	11-24-74	AE	JH
G	1267	3-20-75	EP	JH

DIGITAL BOARD
DISPLAY BOARDDIGITAL BOARD
DISPLAY BOARD

P3 DISPLAY BOARD

P3 DIGITAL BOARD

SELECT VALUE IN TEST.

1. FOR ASSEMBLY DIAGRAM SEE 03785

2. FOR PARTS LIST SEE 03785 DI

3. DIODES ARE 4750D.

4. NPN TRANSISTORS ARE 43107, PNP TRANSISTORS ARE 44305

5. ALL CAPACITANCE VALUES IN MICROFARADS

6. RESISTANCE VALUES IN OHMS 2.5K, 1/2W.

NOTES UNLESS OTHERWISE SPECIFIED

U1M-50	1804	4001	4
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50	1804	4001	4

1. NUMBER: 03787

2. DATE: 11/27/77

3. BY: WBP

4. CHECKED: JH

5. APPROVED: JH

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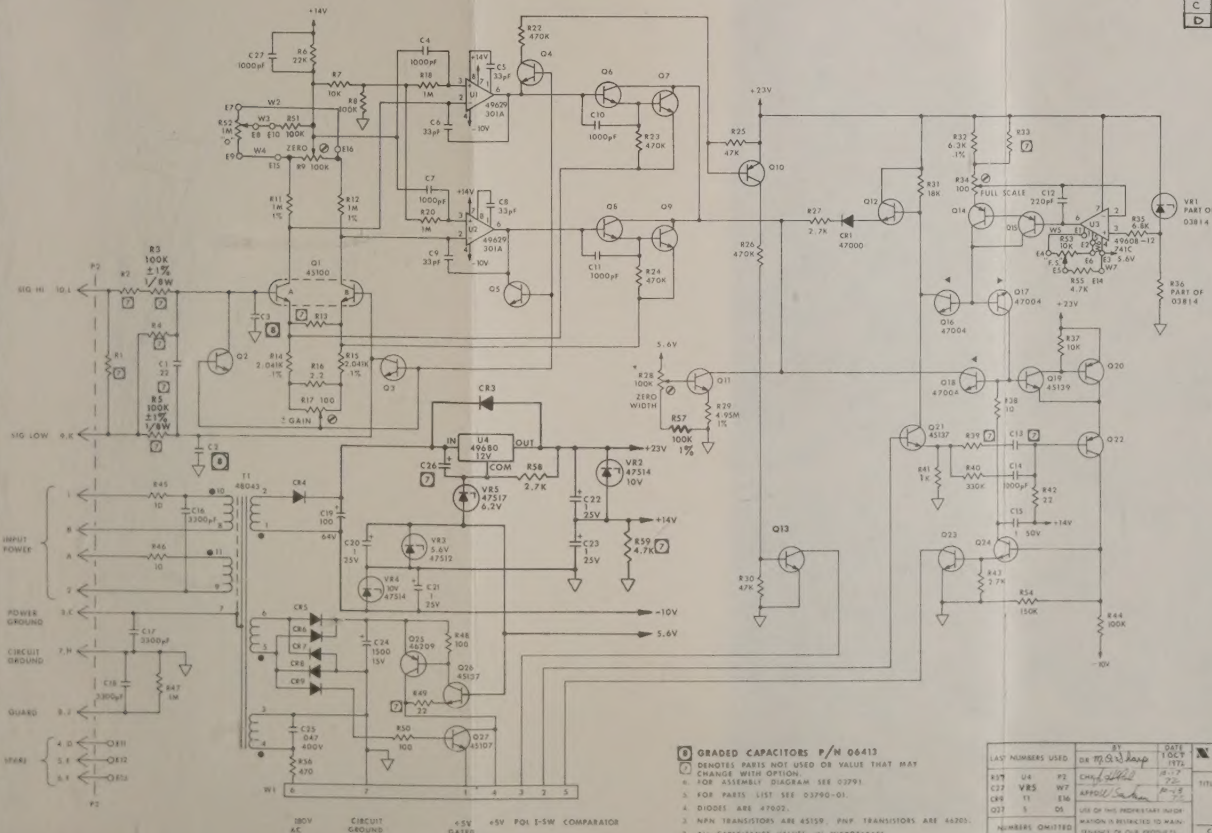
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CHG	E.O. NO.	DATE	BY	CHK
A	646	7 NOV 72	MOS	10
B	656	21 NOV 72	MOS	14
C	1022	30 NOV 72	RS	10
D	1499	8-26-76	sex	10



[B] GRADED CAPACITORS P/N 06413

2 DENOTES PARTS NOT USED OR VALUE THAT MAY CHANGE WITH OPTION.

c. FOR ASSEMBLY DIAGRAM SEE 03791

FOR PARTS LIST SEE 03790-01

4. DIODES ARE 47002.

3. NPN TRANSISTORS ARE 45159. PNP TRAN

2. ALL CAPACITANCE VALUES IN MICROFARADS.

2. ALL CAPACITANCE VALUES IN MICROFARADS
3. RESISTANCE VALUES IN OHMS $\times 10$

LAST NAMES USED		BY <i>DR. M. J. Hays</i>	DATE 1/27	NEWPORT LABORATORIES, INC. 330 E. YOUNG ST. SANTA ANA, CALIF. 92703
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C17 VRS	W7	<i>ARFOLD, S.</i>	A-5	
C17 I1	O6	<i>ARFOLD, S.</i>	A-5	
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